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(54) IMPROVEMENTS IN OR RELATING TO CONNECTING A VALVE CLOSURE MEMBER AND A VALVE STEM

(71) We, DANFOSS A/S., a Danish Company, of DK–6430 Nordborg, Denmark, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to a valve and especially to a detachable connection between a valve stem and a valve closure member.

The present invention provides a valve having a valve closure member and an axially movable valve stem, the closure member and the stem each having respective through-going holes which together define a hole extending transversely relative to the axis of the stem, the stem being attached to the closure member by a pin which is a loose fit in each of the through-going holes and a retaining member being provided which at least partially covers the outer extremities of the transverse hole to prevent dislodgement of the pin.

In this construction, the pin can be inserted in the through-going holes with a sliding fit or an even looser fit without detrimentally influencing the transmission of force between the valve stem and valve closure member. The retaining member prevents the loosely inserted transverse pin from falling out and since it is not subjected to any external forces during operation, very simple means will suffice for holding it against axial movement.

It is particularly advantageous if the transverse pin is loosely fitted in the through-going holes to allow limited pivotal movement between the closure member and the stem and, preferably, through an angle of at least ± 2°, (preferably ± 5°) about all axes at right angles to the axis of the valve stem. Pivoting about the axis of the transverse pin presents no difficulties. On the other hand, pivoting in a plane normal to this axis is restricted by the dimensions of the through-going holes. If the difference between the diameter of the through-going holes in the stem and the closure member and the diameter of the transverse pin is relatively large, one obtains a comparatively large pivoting range, whereas if that difference is relatively small a relatively small pivoting range results.

The retaining member may be restrained against movement relative to the stem and in a direction along the axis of the stem, and may, for example, be an at least partially annular member that can, for example, be screwed over a collar of the closure member through which the transverse pin passes. In general, however, it is sufficient if the retaining member is restrained against movement relative to the stem and in a direction along the axis of the stem, at least in part, by its own resilience, for example if it is an elastic 'O' ring.

In a valve in which the valve closure member is loaded by a valve spring it is recommended that the retaining member is formed by at least one turn of the valve spring. The pin is then held without resorting to an additional constructional component.

This feature has the further advantage that, depsite the loose fitting of the pin, the valve closure member is positively held in position by the spring and, consequently, there is no undesirable noise as the medium flows through the valve. This feature is particularly suitable for valves through which a high temperature medium passes, because the metal of the spring can withstand high temperatures and, at the same time, its coils possess adequate elasticity for forming the retaining member.

It is particularly favourable when the retaining member is resilient if the outer extremities of the transverse hole terminate in a respective groove at the outer periphery

of the valve closure member, and the retaining member engaging in these grooves. In particular, the said grooves may be part of a single annular groove. The walls of the groove in conjunction with the resilience of the retaining member ensure that there will be no axial displacement. To release the coupling, however, the retaining member need merely be pulled out of the groove, whereupon the transverse pin is removed and the valve closure member can be repalced.

A valve constructed in accordance with the invention will now be descrubed, by way of example only, with reference to the accompanying drawing the single figure of which shows a longitudinal section through part of the valve.

Referring to the accompanying drawing, a valve housing 1 comprises two inlet/outlet connectors 2 and 3 as well as a valve seat 4. The housing is closed at the top by a cover 5. The seal 6 of a valve closure member in the form of a plate 7 co-operates with the valve seat 4. The valve plate 7 is connected to an axially adjustable valve stem 9 by a transverse pin 8. An attachment including a power element for actuating the valve stem 9 is omitted from the drawing. The attachment can be of any desired kind and is secured to the top of the housing 1. For example, an attachment as described and illustrated in the Complete Specification of our co-pending British Patent Application No. 4179/76 (Serial No. 1536361) of even date could be employed. A valve spring 10, which is supported at one end by the cover 5 and at the other end by the valve plate 7, presses the plate 7 into its closed position.

The transverse pin 8 passes with play through a transverse hole 11 in the valve stem 9 and through two diametrically opposite transverse holes 12 provided in a collar 13 of the valve plate 7. This play is so large in the holes 11 and 12 that the valve plate 7 has a considerable pivotal range of movement of ± 5° or higher not only about the axis of the transverse pin 8 but also about the axis which intersects and is at right angles to the axis of the pin and is at right angles to the plane of the drawing. The resultant range of pivotal movement about any axis at right angles to the axis of the stem 9 will be made up of the sum of the components of these two movements and consequently the overall freedom of movement of the valve plate will ensure that it properly engages and seals against the valve seat 4 under all circumstances. Since the valve plate 7 is being pressed by the spring 10 against the valve seat 4 in the illustrated position and since the valve stem 9 is likewise urged in this direction by a spring (not shown), the play in the hole 11 can be regarded as being below the transverse pin 8 and the play in the holes 12 above the transverse pin.

The ends of the holes 12 in the collar 13 open into an annular groove 14 coaxial with the stem 9. Engaged in this annular groove 14 is a retaining or securing element 15 which prevents the loosely inserted transverse pin 8 from being dislodged from the holes 11 and 12 and which is formed by the lower two turns of the coiled valve spring 10. These turns are axially compressed together to allow them to be engaged in the annular groove 14. Consequently, once engaged in the groove they are axially fixed in position in the groove under their own resilience. Similarly, the two turns can be removed from the annular groove 14 by pulling them axially apart. The transverse pin 8 can then be removed, for example, to allow the valve plate 7 to be replaced.

/WHAT WE CLAIM IS: –

1. A valve having a valve closure member and an axially movable valve stem, the closure member and the stem each having respective through-going holes which together define a hole extending transversely relative to the axis of the stem, the stem being attached to the closure member by a pin which is a loose fit in each of the through-going holes and a retaining member being provided which at least partially covers the outer extremities of the transverse hole to prevent dislodgement of the pin.

2. A valve as claimed in claim 1, in which the pin is loosely fitted in the through-going holes to allow limited pivotal movement between the closure member and the stem.

3. A valve as claimed in claim 2, in which the transverse pin is fitted in the through-going holes to allow limited pivotal movement between the closure member and the stem through an angle of at least ± 2°, about all axes at right angles to the axis of the stem.

4. A valve as claimed in claim 3, in which the angle is ± 5°.

5. A valve as claimed in claim 1, in which the retaining member is restrained against movement relative to the stem and in a direction along the axis of the stem.

6. A valve as claimed in claim 5, in which the retaining member is restrained against movement relative to the stem and in a direction along the axis of the stem, at least in part, by its own resilience.

7. A valve as claimed in any one of claims 1 to 6, in which the valve closure member is loaded by a valve spring the retaining member being formed by at least on turn of the valve spring.

8. A valve as claimed in any one of claims 1 to 7, in which the outer extremities of the transverse hole terminates in a respective groove at the outer periphery of the valve closure member, and in which the

retaining member engages in these grooves.

9. A valve as claimed in claim 8, in which the said grooves are part of a single annular groove.

10. A valve substantially as hereinbefore described with reference to and as illustrated by the accompanying drawing.

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1536362 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*